Contents

ABSTRACT

Many factors influence a waterbody's functioning. The relationship between temperature and depth was the main focus of this study and materials such as the dissolved oxygen meter and meter ruler were used to carry the investigation, from which data was collected and analysed using 'IBM SPSS Statistics 22'. The results did not follow what was expected theoretically but after careful literature review, such results could be possible. And finally, advice to those who wish to undertake in a similar investigation was given.

INTRODUCTION

It is best that the difference between a pond and a lake is understood. One definition states that a pond is any shallow piece of water in which attached plant growth can occur all over, and that for a water body to be classified as a lake, it has to remain stratified throughout summer. But it also has to be noted that a pond is small and its edges are not considerably eroded by wave action (Magan and Worthington, 1962, p.28-29). Magan and Worthington go on to suggest that the nature of the pond bottom is of immense importance and should comprise of organic matter derived from dead plants and animals, as well as inorganic matter in a fine state of division (1962, p.214).

All these factors are very useful in determining the effects of depth on temperature. It is the aim of this paper to show how these factors interplay in order to determine such effects.

METHODOLOGY

Measurements of depth were taken using a meter ruler at 5cm, 20cm and 35cm below the surface for each pond. And at each depth, a temperature reading was taken using a dissolved oxygen (DO) meter and recorded. This was done for 10 ponds.

Later, the data was analysed using ‘IBM SPSS Statistics 22’ for each depth and graphs were produced, so as to determine the relationship between depth and temperature. With the help of literature, a conclusion was made based on the found data.

RESULTS AND DISCUSSIONS

Table 1: Average temperature readings at each depth.

	Temperature (°C)							
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
Depth (cm)	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
5 cm	10	8.90	20.70	29.60	27.4100	0.79742	2.52166	6.359
20 cm	10	9.70	19.50	29.20	24.5400	1.27882	4.04398	16.354
35 cm	10	9.40	19.20	28.60	25.7100	1.07170	3.38902	11.485

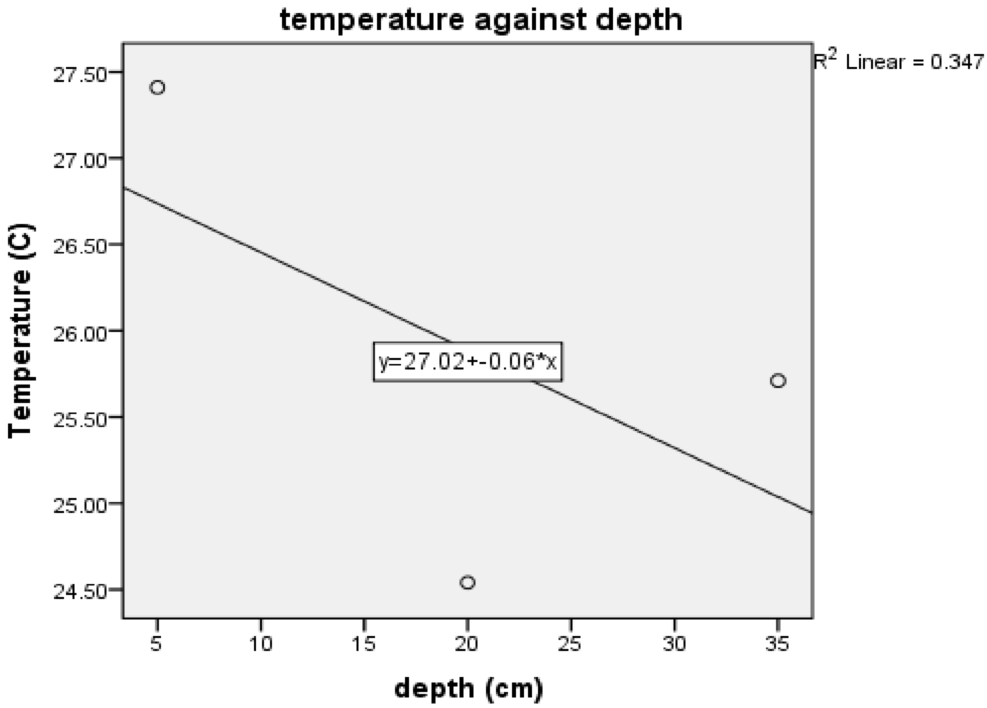

Figure 1.1: Expected relationship between temperature and depth.

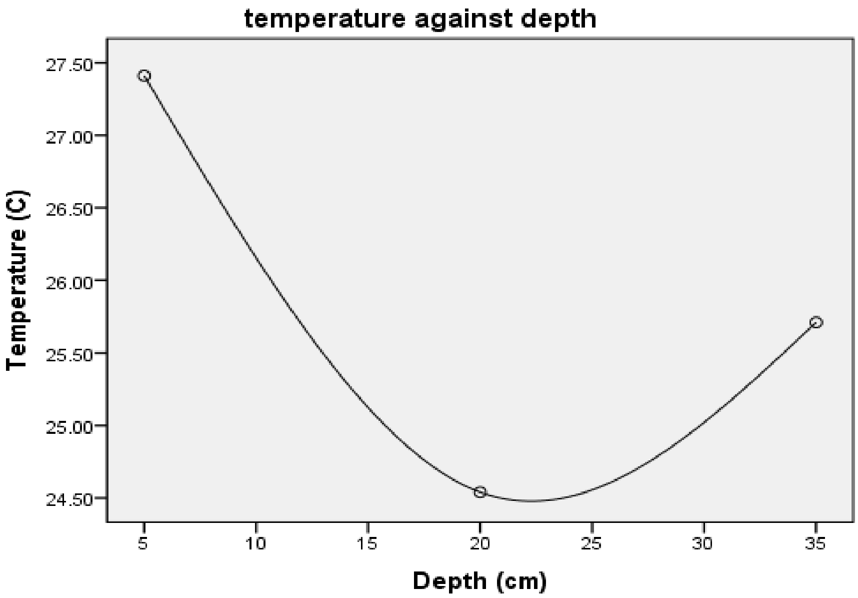

Figure 1.2: Observed relationship between temperature and depth.

When Figure 1.1 and Figure 1.2 were compared, it was noted that what was expected in theory was never achieved in practice. According to Wetzel (2001), in summer, it is expected that a stratified waterbody's temperature decreases with increasing depth because during thermal

stratification, cold water settles at the bottom as it is denser than the warmer top water (p. 74). And this is typical of larger water bodies.

Eby (2004) argues that mixing and overturn are controlled by wind action and climatic conditions. He goes on to say that in the tropics, air temperature is relatively constant throughout the year and that there is no well-defined overturn, as such shallow waters are constantly stirred by wind action and a hypolimnion does not develop (p.335-6).

It was also noted that the first 20-22cm obeyed the supposition that temperature decreases with depth but after that the temperature begun to rise again. As already stated in the introduction, the composition of the pond bottom is of great importance. With respect to Eby (2004), most pond bottoms contain silt or clay particles which are aggregates of silicates and other minerals. As such, there are various water-silicate reactions that can occur to mitigate the effect of acid addition. These reactions proceed more slowly because of kinetic constraints and hydrogen atoms are consumed.

Considering the equation:

$Al_3Si_3O_{10}(OH)_{muscovite} + H^+ + 1.5H_2O \rightarrow 1.5Al_2Si_2O_5(OH)_4 + K^+ + 2H_4SiO_{4(aq)}$ $\Delta G^o_R = -25.25KJmol^{-1}$

(Adapted from Eby, 2004, p.86).

From this reaction, it was observed that 22.25KJmol^{-1} was released as free energy. This free energy would later be converted into thermal energy that the water molecules near the pond bottom would acquire than those further of it. Solids, liquids and highly compressed gases are perfect radiators in that they emit the maximum amount of electromagnetic energy at all wavelengths (Fletcher, 1993, p.245). But a major difference between these states is the separation between the atoms or molecules of the substance, where solids are held by forces originating from within particles themselves with little freedom of movement and liquid particles slightly loose as compared to solids and move under thermal motion (p.16). This is besides the issue of why land heats faster and releases heat faster than water (which is also an important factor for such irregularity). It must be expected that the heat lost by the pond bottom is taken up the surrounding water thus accounting for why the temperature increased.

$\varepsilon = \sigma T^4$: where ε is the total energy emitted in Wm^{-2} by radiator, σ is the Stefan-Boltzmann Constant in $Wm^{-2}K^{-4}$ and T is the temperature in K.

(Adapted from Fletcher, 1993, p.245)

Interestingly, the graph had a characteristic U-shape as the pond received thermal energy form both ends.

CONCLUSION

Even though it was expected that the temperature would decrease with increasing depth, it was not so because many interacting variables had to be considered, like depth, nature of the pond bottom as well as time of the day and location of the pond. In conclusion, all these factors have to be considered before carrying out similar investigations.

REFERENCES

Eby, G.N. (2004). *Principles Of Environmental Geochemistry*. Brooks/Cole Cengage Learning. USA

Fletcher, P. (1993). *Chemical Thermodynamics For Earth Scientists*. Longman, Scientific and Technical.

Magan, T.T. and Worthington, E.B. (1962). *Life In Lakes And Rivers*. Collins Clear-Type Press. London and Glasgow.

Wetzel, R.G. (2001). *Limnology, Lake And River Ecosystems 3rd Ed*. Elsevier Academic Press. USA.